

graphic object having interaction with the interface object is obtained. The attribute information includes surface information of the graphic object and also provides amplitude information necessary for the generation of vibration.

[0060] The drive module 150 receives the motion information and the attribute information from the control module 130 and generates a drive signal corresponding to the information in operation S440 and generates vibration by driving an actuator using the drive signal in operation S450.

[0061] In operation S460, the vibration is transmitted to the user through the interface device so that the user can feel the interaction with the graphic object, which occurs as the interface object moves.

[0062] Meanwhile, the present invention can be used for a game device for a racing game such as Kartrider or other game devices, an interaction map, an interaction mouse, etc. Embodiments of the present invention used for those things will be described in detail below.

[0063] FIG. 5 illustrates a game device 500 according to an embodiment of the present invention, in which a racing game, such as Kartrider, is illustrated by way of example. The game device 500 includes a display area 510 and a user input area (520, 530).

[0064] The display area 510 displays a graphic screen on which a plurality of graphic objects appear. The plurality of graphic objects include an interface object operated by a user. In a racing game, the interface object may be a car 512 representing the user. The user input area includes input buttons used for game control and game play.

[0065] In the current embodiment of the present invention, the user input area includes a four direction button unit 520 and a number button unit 530.

[0066] Here, an input for the game control is an input for selecting game start, game end, game level, game type, or the like. An input for the game play is an input to operate a position or a speed of the interface object. For example, when a user plays a game using the four direction button unit 520 and an action button providing an action function, a left button in the four direction button unit 520 moves the car 512 to the left; a right button moves the car 512 to the right; an up button increases the speed of the car 512; and a down button decreases the speed of the car 512. The action button is used to attack another user or make the car 512 jump. The action button may be a button included in the number button unit 530.

[0067] Alternatively, when a user plays a game using the number button unit 530, number "4", "6", "2" and "8" buttons may provide functions corresponding to the left, right, up, and down buttons, respectively, included in the four direction button unit 520 and a number "5" button may be used to make the car 512 jump. Here, the number "5" button corresponds to the action button.

[0068] FIG. 6 is a functional block diagram illustrating the structure of the game device 500 illustrated in FIG. 5. The structure illustrated in FIG. 6 may correspond to the structure illustrated in FIG. 1, and a description will be made with reference to FIGS. 1, 5, and 6.

[0069] Referring to FIG. 6, a controller 540 corresponds to the interface device module 110 and corresponds to the four direction button unit 520 or the number button unit 530.

[0070] In addition, a set of a car information calculator 545, a road surface information calculator 550, and a rendering module 560 corresponds to the control module 130. A set of a drive circuit 565 and an actuator 570 corresponds

to the drive module 150. A graphic display module 555 corresponds to the display module 170. The graphic display module 555 displays a graphic screen and graphic objects through the display area 510.

[0071] Before describing the operation of the game device 500, a game environment according to an embodiment of the present invention will be described with reference to FIGS. 7 and 8.

[0072] Referring to FIG. 7, it is assumed that a car racing track 720 extends long from a start line 710 in a moving direction of a car. The start line 710 serves as a start point or a reference point of the car racing track 720.

[0073] A dark rectangular area hatched with thick lines is located at a predetermined position on the car racing track 720 and is referred to as a virtual block 730, in which vibration is generated.

[0074] The virtual block 730 may be implemented by a single polygon or the sum of a plurality of polygons in general graphic programs and may have a predetermined area on the car racing track 720.

[0075] Accordingly, the virtual block 730 may be expressed as a part of a graphic object, i.e., the car racing track 720 or as a single graphic object separated from the car racing track 720.

[0076] Meanwhile, two points a_n and b_n may be defined on the virtual block 730 along the moving direction of a car. A distance from the start line 710 to the point a_n is represented with p_n and a distance from the start line 710 to the point b_n is represented with q_n .

[0077] Here, an influence of vibration generated when the car passes a section between the two points a_n and b_n on the car racing track 720, that is, the influence of vibration generated when the car passes an n -th virtual block can be expressed by the sum of vibration considering the delay of the distance p_n and the delay of the distance q_n . This influence of the vibration can be expressed by Equation (1):

$$Vib(L) = h_n \sum_{n=1} [u(L - p_n) - u(L - q_n)], \quad (1)$$

[0078] where L is a moving distance of the car from an initial start to a current time " t ". The moving distance L can be expressed by a general distance equation like Equation (2):

$$L = vt + \frac{1}{2}at^2. \quad (2)$$

[0079] Since the moving distance L may be defined based on a speed at which the car passes an $(n-1)$ -th virtual block and acceleration at which the car passes the point a_n , a time when the car passes a virtual block can be controlled when a user controls the speed of the car corresponding to the interface object.

[0080] In addition, in Equation (1), " h_n " denotes information on the rise and fall of a road surface in a virtual block in a section $[p_n, q_n]$ and is a parameter determining an amplitude of vibration. In other words, when a value of " h_n " is large, a large amplitude is provided. The magnitude of amplitude will be described with reference to FIG. 8.